Investigating the Role of Field Portable Geochemical Instrumentation in Planetary Field Geologic Operations

K.E. Young, J. E. Bleacher, C. A. Evans, and A. McAdam

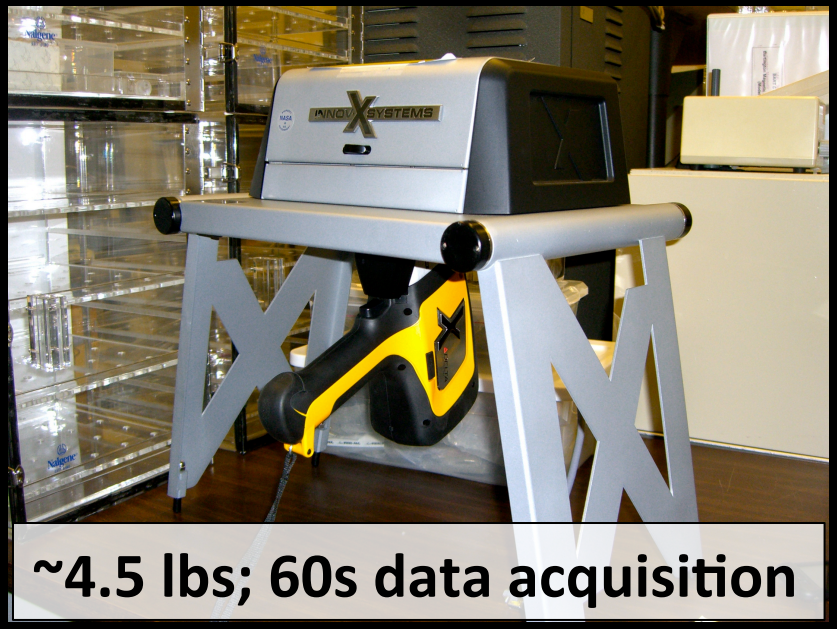
Field Portable Instrumentation

- Goal of any instrument is to maximize science return and increase efficiency of real-time surface operations

- Influences not only sample collection, but also in situ data analysis to inform traverse activities

- RIS4E Theme 2 investigates the relationship between in situ scientific analysis and operational constraints

Handheld XRF Technology

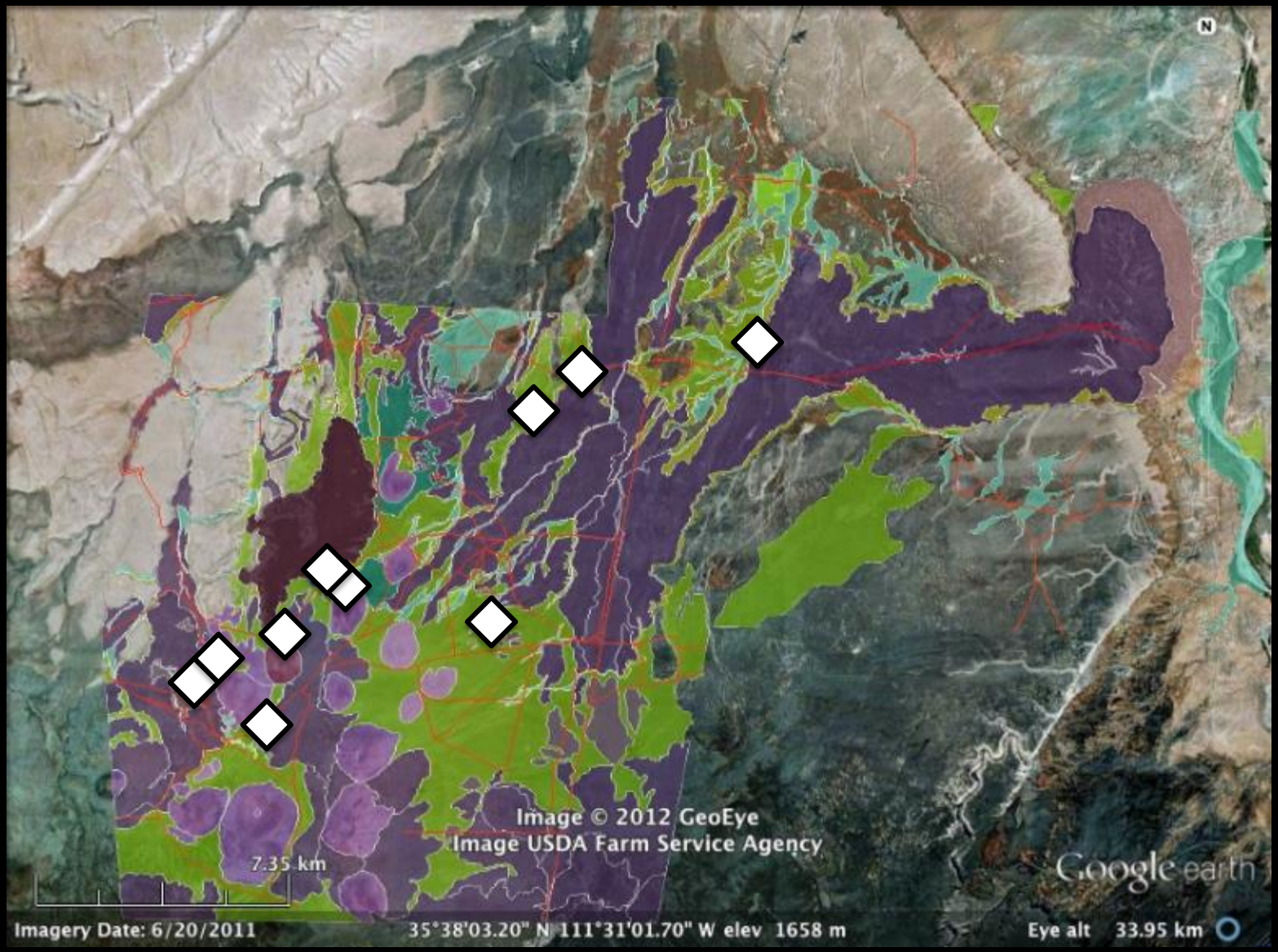


- COTS technology originally developed for industry
- Deployment of our instrument based on 5+ years of laboratory analysis to build unique calibration curves

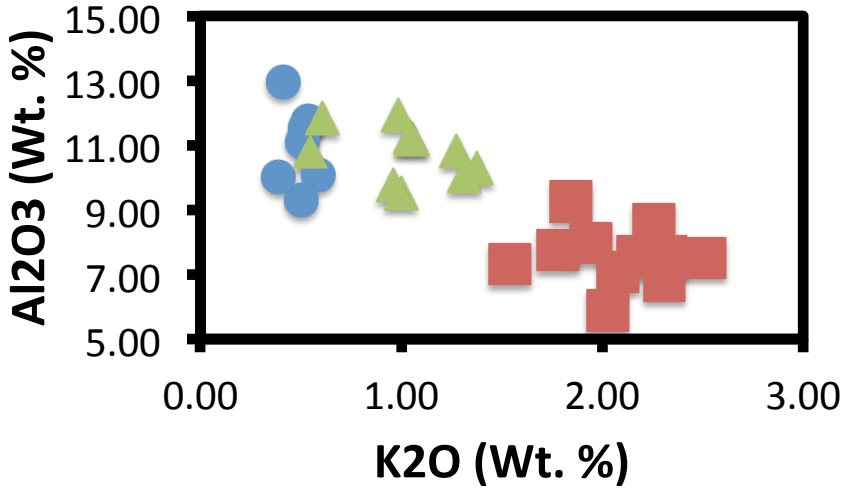
Desert RATS 2010

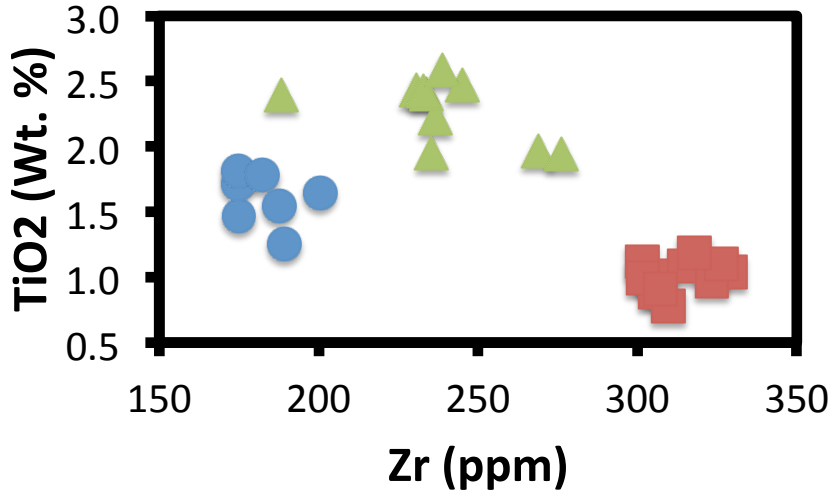
- San Francisco Volcanic Field, NW AZ
- 4 crews conducted week-long traverses (~3 EVAs/day) geared toward sample collection and geologic observations of the area

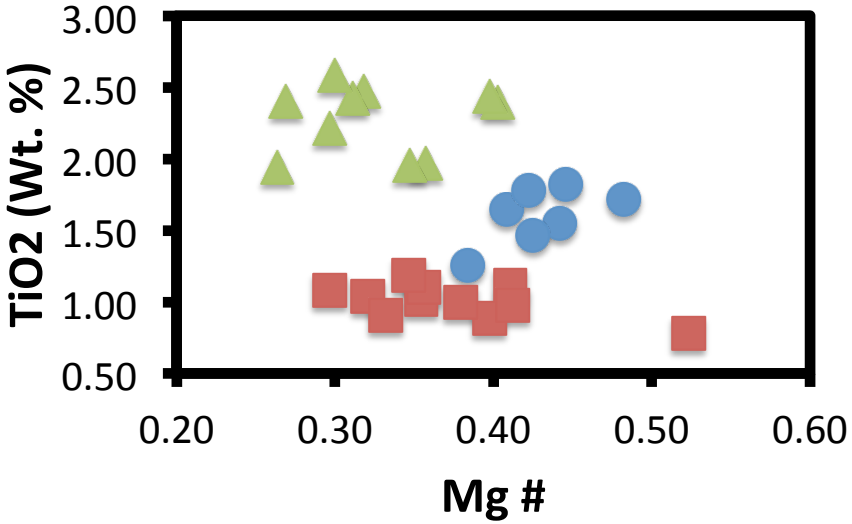
hXRF Case Study: DRATS 2010



hXRF Data





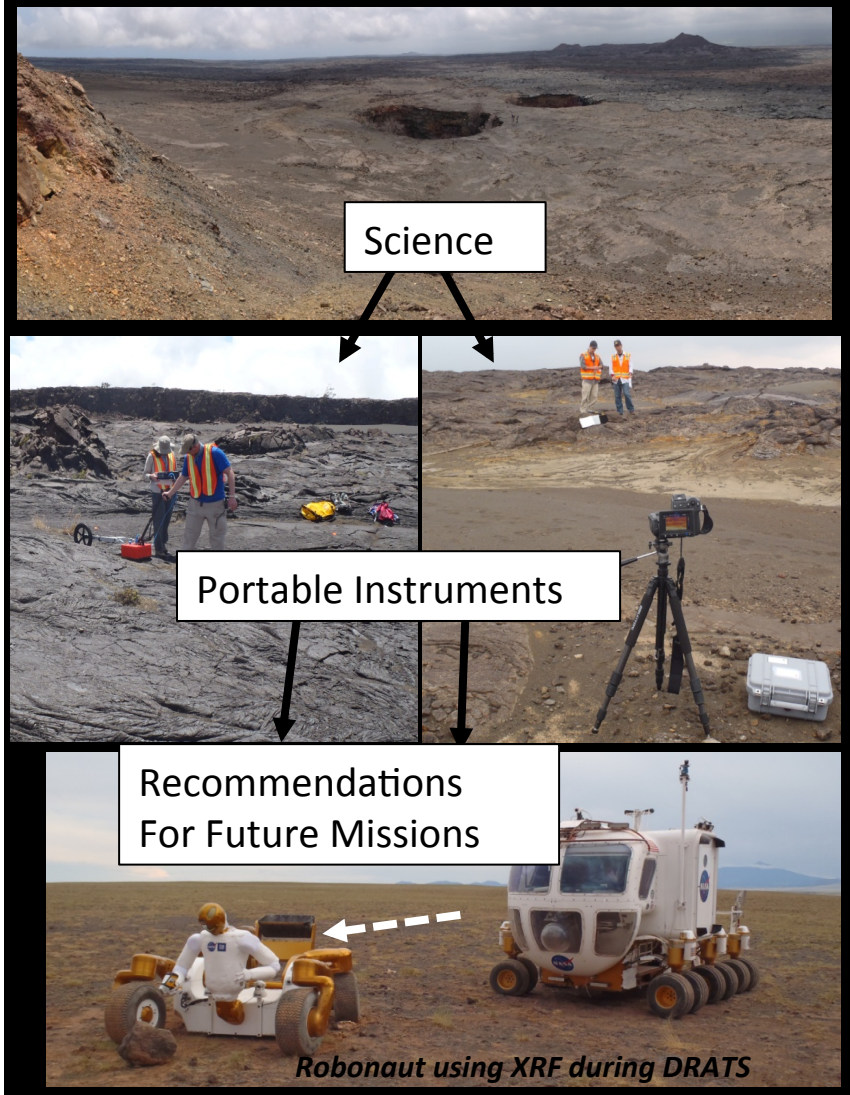


Unit Descriptions

- Unit vf1: low Al, high K, high Zr, low Ti, mid Mg #
- Unit vf2: high Al, low K, low Zr, mid Ti, mid Mg #
- Unknown unit: high Al, low K, mid Zr, high Ti, low Mg #

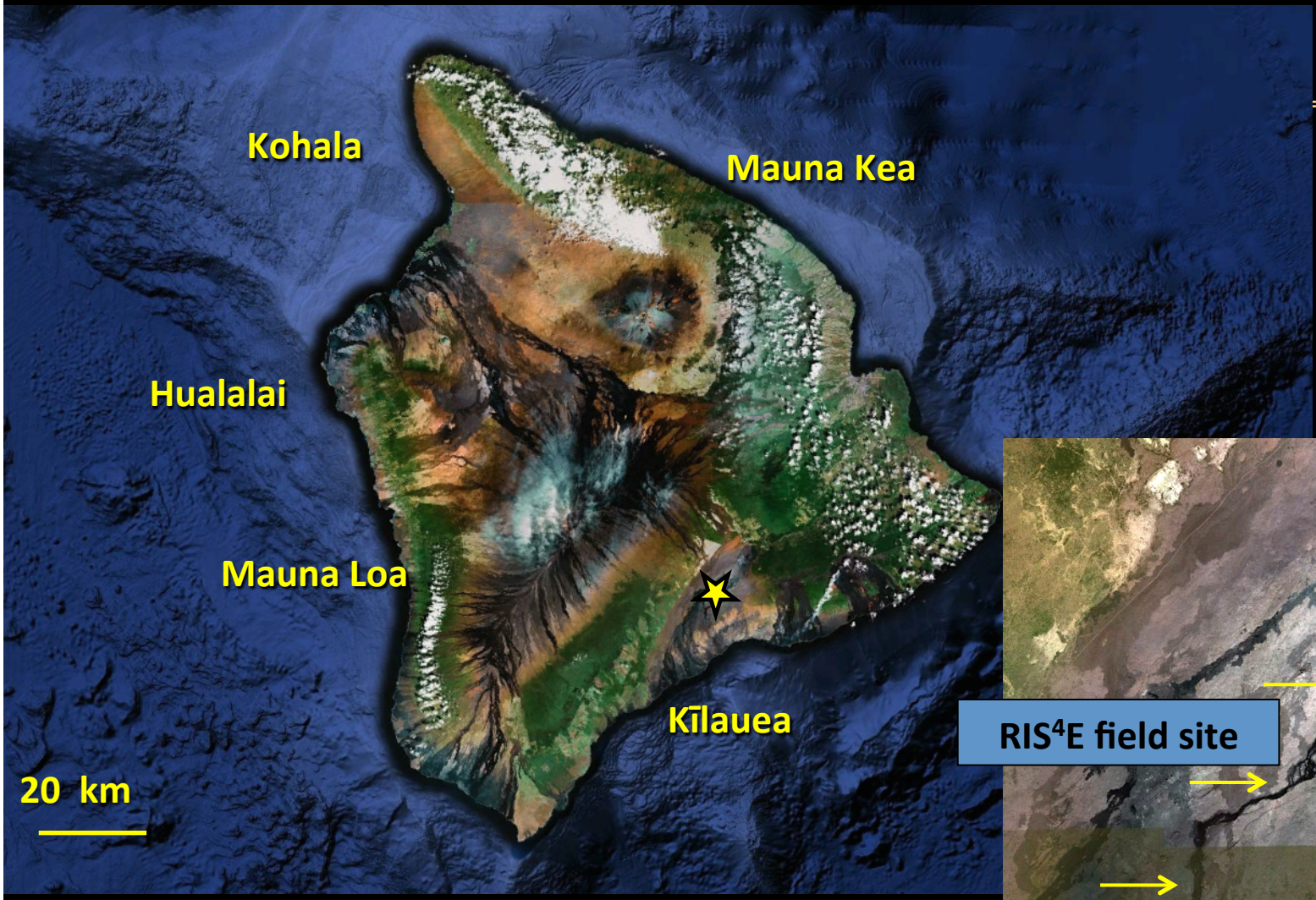
hXRF Case Study: DRATS 2010

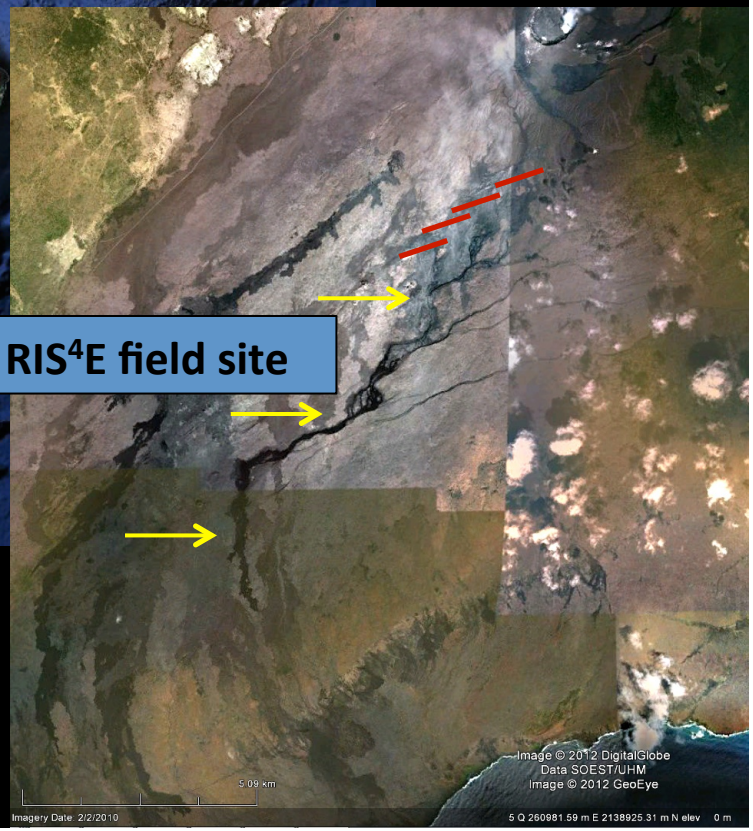
RIS4E Field Team Goals



Where is the link between current field portable technologies and implementation strategies for planetary field geology?

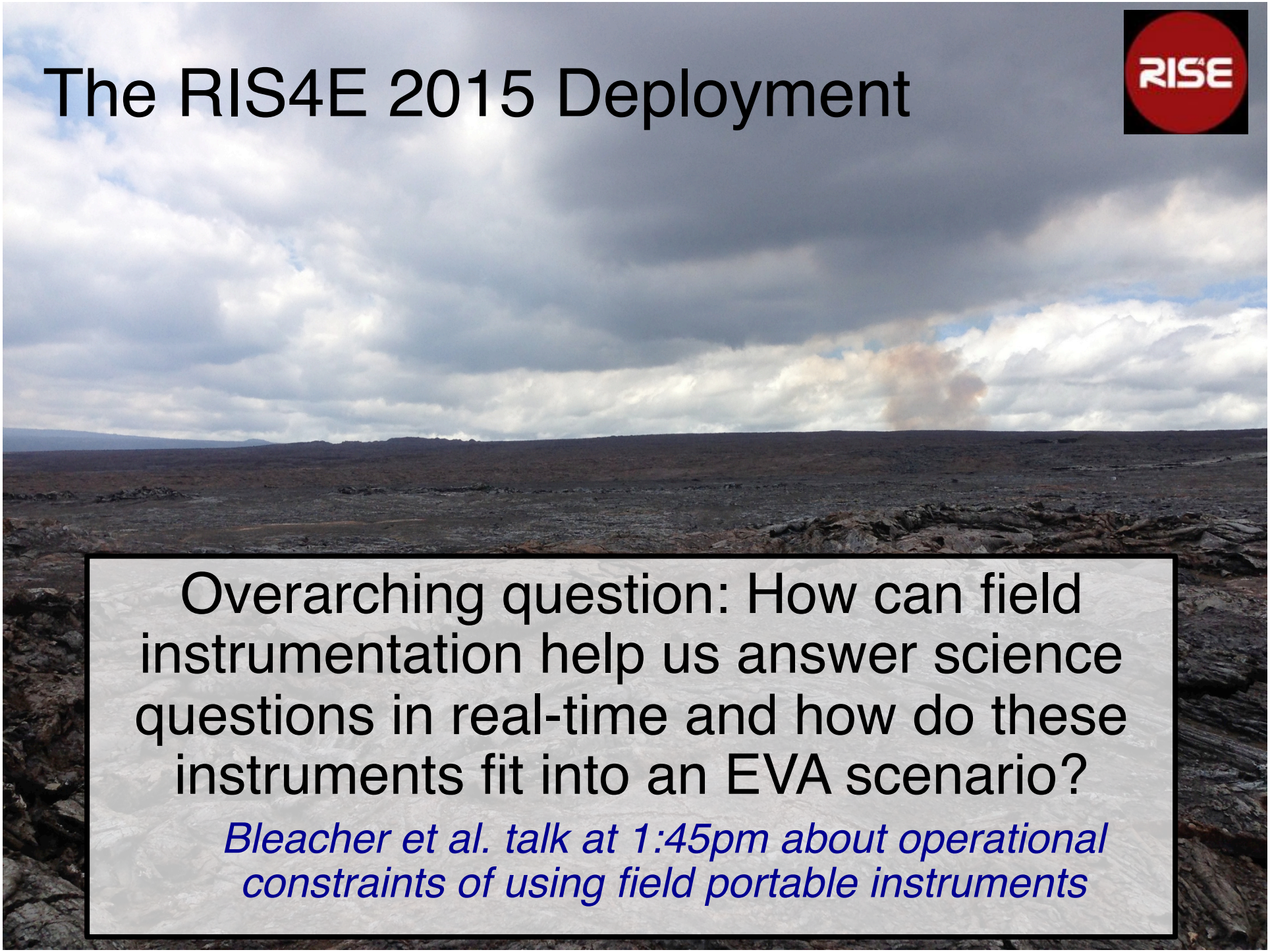
RIS^{4}E FIELD SITE: Kīlauea December 1974 Flow





RIS^{4}E field team building on 6 years of PGG & MMAMA-funded research to study physical volcanology & characterize chemistry & mineralogy of lava and alteration products

The RIS4E 2015 Deployment

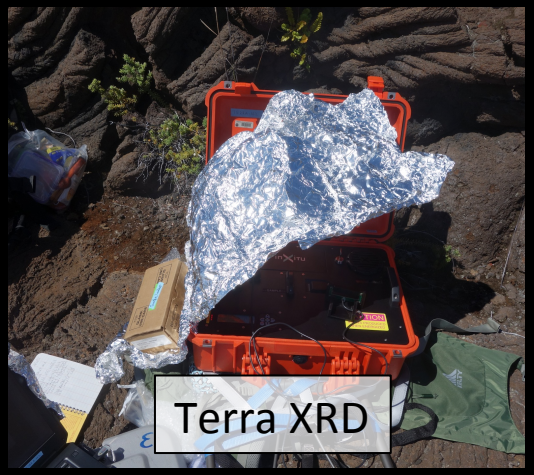


Overarching question: How can field instrumentation help us answer science questions in real-time and how do these instruments fit into an EVA scenario?

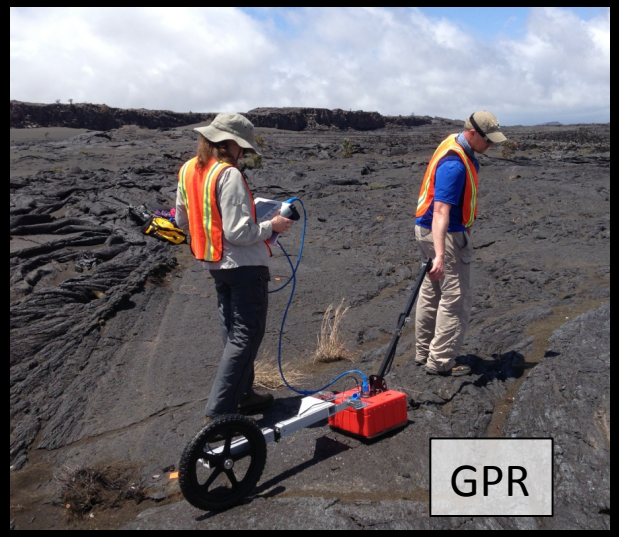
Bleacher et al. talk at 1:45pm about operational constraints of using field portable instruments

RIS4E Field Instrumentation


Multispectral Imager


Terra XRD


LiDAR


GPR


Handheld XRF


Kite-based data

See Ito et al talk at 1:30pm for details on multispectral imager

D1974

This study: Explore the geochemical and mineralogical diversity of the D1974 flow in situ

D1974 – Alteration Coatings

- What are the coatings made of?
- How do these coatings form?
- How does coating chemistry vary across the entire flow?
- How thick are they and how do they interact with the bulk D1974 flow?

Handheld XRF data suggest the coatings are enriched in Si, Ti, and Fe relative to the bulk D1974 flow.

D1974 – Sulfatara

High density in situ geochemical analyses of thermally-active area

D1974 – Sulfatara

High density in situ geochemical analyses of thermally-active area

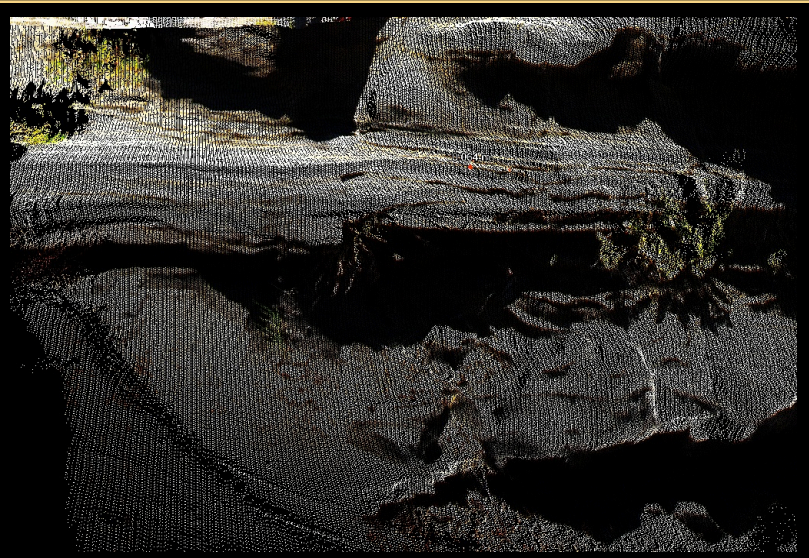
D1974 – High Density Sampling

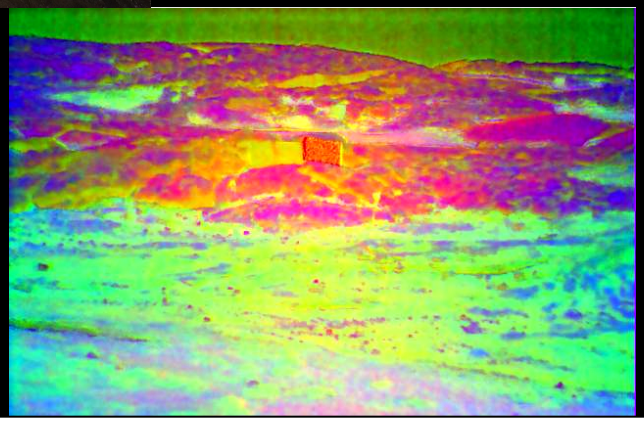
- High spatial resolution measurements
- Non-destructive
- Preserves geologic context

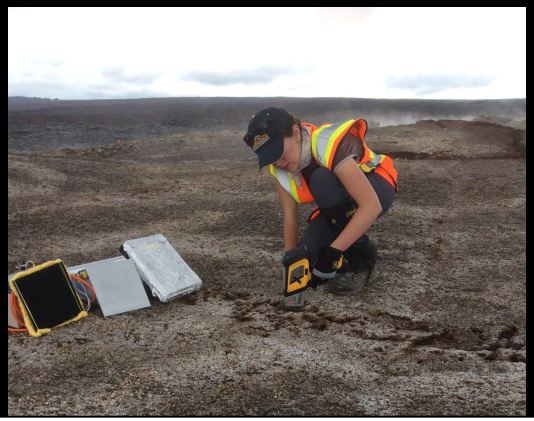
Comparing Lab and Handheld Data

- Comparing field measurements with laboratory analyses done at Franklin & Marshall
- Each data set answers different questions

Integrating Data Sets







Data products that influence in situ exploration will combine multispectral, geochemistry, and texture information

Summary

- What is the ideal instrumentation suite needed for in situ exploration?
- Geochemical science themes
  - Alteration coatings
  - Detailed and high-resolution in situ geochemical and mineralogical mapping
  - Generation of data products combining multiple instrument streams

- *Ito et al., 1:30pm – Multispectral Imager*
- *Bleacher et al., 1:45pm – Operational constraints of using instrumentation*